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THE RELATIONSHIP OF FOUR FACTORS (INTELLIGENCE QUOTIENT, MENTAL AGE, CHRONOLOGICAL AGE, AND ARITHMETICAL ABILITY), WITH ACHIEVEMENT IN FIRST-YEAR BOOKKEEPING

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THE RELATIONSHIP OF FOUR FACTORS (INTELLIGENCE QUOTIENT,
MENTAL AGE, CHRONOLOGICAL AGE, AND ARITHMETICAL ABILITY),
WITH ACHIEVEMENT IN FIRST-YEAR BOOKKEEPING

A Thesis Submitted to the Graduate Division in Partial
Fulfillment of the Requirements for the
Degree of Master of Science

By

Richard Stanley Seymour

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KANSAS STATE TEACHERS COLLEGE

Pittsburg, Kansas

July, 1954

WITHDRAWN

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ABSTRACT

The purpose of this study is to determine if any of these four factors (intelligence quotient, mental age, chronological age, and arithmetical ability) are valid measures for prognosticating success in first-year bookkeeping.

The bookkeeping students for three consecutive years (1950-51, 1951-52, 1952-53) were grouped together and their achievement in relation to IQ, CA and MA was compared to the achievement of the 1953-54 bookkeeping students through use of scattergrams, by percentages for the entire group and percentages by classification (sophomore, junior and senior).

The 1953-54 bookkeeping students were given the Hundred-Problem Arithmetic Test and their probable bookkeeping success in relation to percentile ranking (based on the national norm for this test) was compared to their actual bookkeeping success in the same manner as that used for IQ, CA and MA.

The writer came to the conclusion that intelligence quotient and chronological age are perhaps more influential in predicting probable success in bookkeeping than mental age and arithmetical ability.

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CHAPTER I

INTRODUCTION

Statement of the Problem

The purpose of this study is to determine if any of these four factors (intelligence quotient, chronological age, mental age, and arithmetical ability) are valid measures for prognosticating probable success in first-year bookkeeping.

Need for the Study

With the increase of the school population in recent years, and the continuation of this trend, it is imperative that our school program be modified to meet the needs of all students. As part of this needed modification, wise selection of students for the various courses is necessary. It is agreed that not all students will succeed in a given course. It becomes desirable, therefore, to have some criteria for placing students in a program in which they can attain a reasonable degree of success.

Possibly other teachers and/or administrators could use these four factors in selecting and guiding students for first-year bookkeeping.

It is hoped that the four criteria used in this study will, to some extent, be valuable measures of possible success in bookkeeping.

Limitations of the Study

One of the major limitations of the study is the small number of students involved. According to Ross and Stanley¹ "... the larger the sampling, the better...."

The instruction varied to some extent from year to year. Also the tests given to determine the final grade (achievement) were not the same tests. These tests did cover, however, the same material and were of comparable difficulty.

Student interest in the course constitutes a major limitation to a study of this type. "In many cases, moreover, mere intellectual ability is not the sole criterion. Interest, personal appearance, family connections, and other factors may more than counteract a mediocre intellectual ability."² House³ stated: "... interest in bookkeeping was found to have a great influence on success."

Statistical methods, as such, were not used, i.e., the standard deviation, probable error, coefficient of correlation, etc. were not determined.

The Otis Quick-Scoring Test⁴ was used to determine the intelligence quotients of the bookkeeping students. One test

¹C. C. Ross and Julian C. Stanley, Measurement in Today's Schools (New York: Prentice-Hall, Inc., 1954), p. 103.

²Herbert A. Tonne, Principles of Business Education (New York: Gregg Publishing Company, 1947), p. 244.

³F. Wayne House, "Factors Affecting Student Achievement in Beginning Bookkeeping" (unpublished doctoral study, Ohio State University, 1951), p. 53.

⁴Oscar Krisen Buros, The Third Mental Measurements Yearbook (New Brunswick: Rutgers University Press, 1949), pp. 328-9.

can only give an indication of IQ, whereas a battery of IQ tests would produce a more accurate indication of intelligence quotient.

Definition of Terms

Intelligence Quotient (IQ) is, "the most commonly used device for expressing level of mental development in relation to chronological age; obtained by dividing the mental age (as measured by a general intelligence test) by the chronological age and multiplying by 100."⁵

Mental age (MA) means, "the level of a person's mental ability expressed in terms of the median chronological age of a person having the same level of mental ability."⁶

$$\frac{CA \cdot IQ}{100}$$

Chronological age (CA) is, "the amount of time that has elapsed since an individual's birth."⁷ In this study, the chronological age was computed as of May 20th of each year, the date final grades were given.

Achievement means, "accomplishment or proficiency of performance in a given skill or body of knowledge."⁸ As used

⁵ Carter V. Good, Editor, Dictionary of Education (New York: McGraw-Hill Book Company, Inc., 1945), p. 324.

⁶ Ibid., p. 16.

⁷ Loc. cit.

⁸ Ibid., p. 6.

in this study, achievement means the final grades for the year in first-year bookkeeping.

The grading scale used by the researcher in evaluating bookkeeping students is presented below:

A	93-100%
B	85- 92
C	78- 84
D	70- 77
<hr/>	
F	below 70%

Scattergram refers to, "a double-entry table in which a tally mark, dot, or other symbol is entered for each observation at the intersection of the column and row corresponding to the X and Y scores of that observation; frequently used for determining the coefficient of correlation between two variables, as well as for inspection of data, curve fitting, etc. (sometimes applied to a correlation table after the entries have been tallied)."⁹

Prognosis, "statistically, means the act or process of predicting the value of a dependent variable by means of known values of one or more independent variables."¹⁰

Prediction, as used in this study means the actual past results obtained from the 1950-51, 1951-52, 1952-53 bookkeeping students.

⁹Ibid., p. 130.

¹⁰Ibid., p. 311.

Arithmetic ability pertains, in this study, to the score attained on the Hundred-Problem Arithmetic Test (revision of Schorling-Clark-Potter).

Hundred-Problem Arithmetic Test¹¹ is a revision of the Schorling-Clark-Potter Arithmetic Test and is designed for grades 7-12. It contains items on addition, subtraction, multiplication, division, fractions, decimals, and percentage. This test is published by the World Book Company, Yonkers, New York, copyright 1928-38.

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Curve, normal probability, is

... the graphical representation of the theoretical distribution of an infinitely large number of observations of a continuous variable varying purely by chance, resulting in a perfectly smooth, symmetrical, bell-shaped curve, having the mean, median, and mode coinciding, and which is expressed in mathematical terms as a curve whose height taken at any point on the horizontal axis is in inverse proportion to the antilogarithm of half the squared sigma distance of that point from the mean. (The normal probability curve and the normal distribution are purely theoretical mathematical concepts. They may be approached in practice but probably are never actually attained.)¹²

Method of Procedure

The relationships of intelligence quotient, chronological age, and mental age to achievement in first-year bookkeeping were plotted on scattergrams, using the bookkeeping

¹¹Oscar Krisen Buros, The Third Mental Measurements Yearbook (New Brunswick: Rutgers University Press, 1949), p. 432.

¹²Good, op. cit., p. 116.

students for the years 1950-51, 1951-52, 1952-53 at Turner high School, Turner, Kansas. While this information is not in itself a prediction, in this study it will be used as such, i.e., we will assume that the grades for the 1953-54 students will fall into the pattern as set by the 1950-51, 1951-52, 1952-53 bookkeeping students.

These scattergrams were then broken down in two different ways: the percentages in each grouping without regard to classification, and the percentages in each grouping according to classification (seniors, juniors and sophomores).

The incoming students were given the Hundred-Problem Arithmetic Test at the beginning of the year.

Four expectancy tables were made, indicating the probable achievement of the 1953-54 first-year bookkeeping students based upon the following factors: IQ, CA, MA and arithmetic ability.

Finally, four scattergrams were made showing the actual achievement of the students in the four areas. These scattergrams were compared with the previous scattergrams to determine the value of these measures.

Related Literature

A study of the Business Education Index from 1927 to the present revealed very little, if any, material similar to the writer's study. A thesis by Harold W. Strauss, in 1930, was

somewhat similar to this study except that the course was for one semester and was offered to freshmen (9th grade). Strauss stated:

As far as the writer has been able to determine no experiment has ever been undertaken to prove the value of arithmetic in the determination of a student's success in bookkeeping.

Frank Henry Kramer, of Somerville, New Jersey, prepared a thesis in partial fulfillment of the requirements for the degree of Doctor of Philosophy (1920) in which he names 120 Schools and Departments of Education of the higher educational institutions in the United States and Canada, to which he wrote requesting a list of experiments conducted in commercial branches. In addition to this, letters, asking for bibliographies were sent to about thirty libraries, and institutions and individuals who would be likely to have information on the matter. The replies were tabulated in the thesis and there appeared no indication of an experiment similar to this one ever having been conducted.

For the period since 1920, a careful search has been made of the Monthly Record of Current Education Publications (US Bureau of Education), Reader's Guide to Periodical Literature and reports of educational associations with similar results.¹³

... we would not be as accurate in our prediction of a student's success in bookkeeping based solely upon his achievement in arithmetic but that we would be compelled to consider his IQ as well.¹⁴

Strauss draws the following conclusions of which number one is omitted because it is of no significance to this study:

II. Success in bookkeeping can be predicted with more than ordinary degree of accuracy, given a student's IQ and State Examination mark
... the multiple coefficient of correlation

¹³Harold W. Strauss, "The Effect of General Intelligence and Achievement in Arithmetic on Success in Bookkeeping" (unpublished master's thesis, Rutgers University, 1930), pp. 15-16.

¹⁴Ibid., p. 28.

between the bookkeeping score on the one hand and the IQ and State Examination marks taken as a team on the other = (+ .82) is very high.

III. The IQ is more reliable than the State Examination as a base upon which to predict a student's success in bookkeeping.

IV. The relative weight of the IQ as compared to the State Examination in the determination of a student's score in bookkeeping is more than 2:1.

In the application of statistical results it should be remembered that the student often loses his individuality and very few of his qualities can be measured statistically. Therefore, common sense should guide the user of any statistical results obtained in this report. Statistics, as such, are excellent guides and indicators, but a too vigorous adherence to them will defeat their own purpose. They should serve as means to a desired end and never as an end in itself.¹⁵

In addition to the IQ, Strauss also correlated a state examination mark with success in bookkeeping.

An article from the Ohio Business Teacher revealed the synopsis of a thesis by Galen Sutsman in 1947.

An attempt was made in this study to find possible bases from the past scholastic records of students which have prognostic values for future success in bookkeeping.

A random selection was made from the record cards of 343 students who had studied one or more semesters of bookkeeping while enrolled at East High School, Columbus, Ohio. The intelligence quotients, attendance records, and grades received in selected junior and senior high school subjects were tabulated and correlations made with grades in 10B bookkeeping.

¹⁵Ibid., pp. 42-7.

1. The Intelligence Quotient was found to have very little prognostic value for bookkeeping, except that students having lower than 90 IQ did generally unsatisfactory work.

2. Junior business training and business arithmetic had about equally low correlations with LOB bookkeeping, and students who had not studied these subjects appeared to succeed as well in bookkeeping as those who had studied them.

3. English showed the highest correlation with bookkeeping of any of the subjects used in this study.

4. First semester bookkeeping appeared to predict only slightly the success to be expected in the second semester.

5. A fairly high correlation was found between first and second year bookkeeping.

6. Attendance had only slight effect on grades received in bookkeeping until attendance dropped below 80 per cent.¹⁶

House came to the following conclusions:

The intelligence quotient was a strong factor in learning bookkeeping as measured by standardized tests with correlations ranging from .47 to .77 ... the intelligence quotient showed little relationship to learning bookkeeping as measured by teachers' final grades with correlations ranging from .11 to .49 ... arithmetic ability was a major factor of success in bookkeeping as measured by standardized tests with correlations ranging from .40 to .51 and as measured by teachers' grades with correlations ranging from .219 to .611.¹⁷

When measured by standardized tests, there is a significant relationship between achievement in beginning bookkeeping and intelligence.¹⁸

¹⁶Galen Stutsman, "A Study of Some Bases for Prognosis in Bookkeeping," Ohio Business Teacher, VIII (April, 1948), 25-6.

¹⁷House, op. cit., pp. 51-2.

¹⁸Ibid., p. 269.

CHAPTER II

INTERPRETATION OF DATA

Introduction. This chapter has been divided into four major sections so that the reader may have all of the information concerning any one phase of the study all in one section without having to move back and forth throughout the chapter to find related material. The sections are in the following order: intelligence quotient, chronological age, mental age and arithmetical ability.

Each section is developed as follows: separate tables are used to show the relationship percentagewise of a particular factor to achievement in first-year bookkeeping using first, the entire group (1950-51, 1951-52, 1952-53 students); then the sophomores, followed by the juniors and finally the seniors. The upper number in each cell represents past results (1950-52) and the lower number represents current results (1953-54). Scattergrams showing this information are in the Appendix.

The IQ intervals were chosen for convenience in handling and because they are usually referred to in this manner (70-79, 80-89, etc.).

In determining the placement of students on the scattergrams which indicate the prediction of 1953-54 bookkeeping grades (see Table XXVII, p. 56), the percentage of sophomores, juniors and seniors having an IQ in a given range was

determined (see Table XXVI, p. 55), and this same percentage of students was used to make Table XXVII, p. 56. For example: on Table XXVI, p. 55, in the range 100-109 there were 30 sophomores: none made "F"; five, or 17%, made "D"; 13, or 43%, made "C" or below; five, or 17%, made "A"; 17, or 57%, made "B" or above and 25, or 84%, made "C" or above. In applying these same percentages to the 1953-54 bookkeeping students it may be observed that there are only 20 students in this interval. We now observe that one, or 6%, made "F"; four, or 25%, made "D" or below; 11, or 69%, made "C" or below; none made "A"; five, or 31%, made "B" and 12, or 75%, made "C" or above. In some cases the percentages necessitated placing a student between two grade columns, thus on the scattergram, Table XXVII, p. 56, there is a symbol in between the "B-C" columns and one in between the "C-D" columns.

This same procedure was used in connection with sophomores, juniors and seniors to predict the 1953-54 bookkeeping grades in all four categories: IQ, MA, CA and arithmetical ability.

Comparison of Intelligence Quotient with Final Grade Achievement

Tables XXVI, XXVII and XXVIII (pp. 55-57, respectively) are scattergrams showing the relationship between IQ (Intelligence Quotient) and achievement in first-year bookkeeping.

The symbol (π) represents sophomores; the ($\#$), juniors and the (\circ) seniors. Table XXVI shows the distribution of grades for the years 1950-51-52, or the past results; Table XXVII shows the predicted results for the year 1953-54; Table XXVIII shows the current grade results for the year 1953-54.

Table I, p. 13, is presented which shows this relationship percentagewise without regard to classification, i.e., sophomore, junior and senior students grouped together. The number above shows the past results and the number below reveals the actual results.

A sample row from this table and subsequent tables will be discussed in detail and a similar discussion may be developed for the remaining rows of each table.

The range 100-109 IQ, with 38 students shows that six, or 16%, made "A"; 21, or 55%, "B" or better; 31, or 81%, "C" or better; none made a grade of "F"; seven, or 18%, "D" or below; 17, or 44%, "C" or below. The comparison shows that of 20 students just completing the course in bookkeeping none made a grade of "A"; five, or 25%, made "B" or above; 14, or 70%, made "C" or above; one, or 4%, made a grade of "F"; six, or 30%, made "D" or below and 15, or 75%, made a grade of "C" or below.

A breakdown by percentages of the relationship between IQ and achievement in first-year bookkeeping for sophomores is shown in Table II, page 14. This group was discussed in the introduction to this chapter, pages 10-11.

TABLE I

COMPARISON BY PERCENTAGE OF PREVIOUS AND CURRENT STUDENTS
FOR WHOM AN IQ WAS AVAILABLE

IQ	Achievement in Bookkeeping				Number of Cases
	P	F	D	C	
120-129	P	-	-	100%	1
	A	0	0	0	0
110-119	P	0	14%	24%	21
	A	0	12%	38%	8
100-109	P	0	18%	26%	38
	A	5%	25%	45%	19
90-99	P	10%	37%	33%	49
	A	0	36%	36%	22
80-89	P	18%	35%	41%	17
	A	29%	57%	0	7
70-79	P	0	50%	0	2
	A	0	0	100%	1

P - Past Results
A - Actual Results

TABLE II

COMPARISON BY PERCENTAGE OF PREVIOUS AND CURRENT SOPHOMORES
FOR WHOM AN IQ WAS AVAILABLE

IQ	Achievement in Bookkeeping				Number of Cases
	P	D	C	A	
120-129	P A	100% 0			1 0
110-119	P A	16% 16%	26% 34%	32% 16%	19 6
100-109	P A	0 6%	27% 44%	17% 31%	30 16
90-99	P A	13% 0	26% 43%	3% 19%	39 16
80-89	P A	21% 40%	43% 0		14 5
70-79	P A	100% 0			1 0

P - Past Results
A - Actual Results

The percentages for juniors are found in Table III, page 16. In the row, 100-109, the previous student made a grade of "B" and the 1953-54 student also made a grade of "B".

Of the seven seniors shown in Table IV, page 17, in the row 100-109, one, or 14%, made "A"; three, or 43%, made "B" or better; five, or 72%, made "C" or better; none made "F"; two, or 29%, made "D" and four, or 58%, made "C" or below. For the current year (1953-54) we find only one student in this row and he scored a grade of "C".

It should be noted that a senior with an IQ in range 70-79 scored "C" while the sophomores in the next higher IQ range, 80-89, scored "D" and "F". This indicates that the seniors made better grades percentagewise than did the other classes.

According to the cumulative percentages shown on Table V, page 18, the comparison is more accurate as we look from grade "C" and above, and from "C" and down. As we moved from the middle grade (C) to the two extremes, "A" and "F", the comparison grows less accurate, because of the decreasing limits of grade span which takes in a smaller number of cases. Only those areas in which the majority of students appeared are shown.

TABLE III

COMPARISON BY PERCENTAGE OF PREVIOUS AND CURRENT JUNIORS
FOR WHOM AN IQ WAS AVAILABLE

IQ	P	Achievement in Bookkeeping			Number of Cases
		D	C	B	
120-129	P	-	-	-	0
	A	-	-	-	0
110-119	P	-	-	100%	1
	A	-	-	100%	1
100-109	P	-	-	100%	1
	A	67%	33%	0	3
90-99	P	-	-	33%	3
	A	-	0	0	0
80-89	P	50%	50%	-	2
	A	100%	-	-	1
70-79	P	-	-	-	0
	A	-	-	-	0

P - Past Results
A - Actual Results

TABLE IV

COMPARISON BY PERCENTAGE OF PREVIOUS AND CURRENT SENIORS
FOR WHOM AN IQ WAS AVAILABLE

IQ	P	Achievement in Bookkeeping			Number of Cases
		D	C	A	
120-129	P	-	-	-	0
	A	-	-	-	0
110-119	P	-	-	100%	1
	A	-	100%	-	1
100-109	P	29%	29%	14%	7
	A	-	100%	-	1
90-99	P	14%	57%	14%	7
	A	33%	17%	0	6
80-89	P	-	100%	-	1
	A	-	100%	-	1
70-79	P	-	100%	-	1
	A	-	100%	-	1

P - Past Results
A - Actual Results

TABLE V

COMPARISON BY CUMULATIVE PERCENTAGE OF PREVIOUS AND CURRENT STUDENTS FOR WHOM AN IQ WAS AVAILABLE

IQ		Achievement in Bookkeeping					Number of Cases
		F	D and Below	C and Below	C and Above	B and Above	
110-119	P	0	14%	38%	86%	62%	21
	A	0	12%	50%	88%	50%	8
100-109	P	0	16%	44%	81%	55%	38
	A	5%	30%	75%	70%	25%	19
90-99	P	10%	47%	80%	53%	20%	49
	A	0	36%	72%	63%	27%	22
80-89	P	18%	53%	94%	47%	6%	17
	A	27%	86%	86%	14%	14%	7

P - Past Results
A - Actual Results

The comparison between previous sophomores and the present sophomores taking bookkeeping, Table VI, page 19, was the most accurate possibly because this class represented the greatest number of students comprising the study. For grade "C" and above there was no change; grade "C" and down an increase from 66 per cent to 74 per cent. The comparison of probable success for the seniors was the next most accurate: for grade "C" and above there was a decrease from 82 per cent to 80 per cent, and for grade "C" and below there was an increase from 53 per cent to 60 per cent. The comparison for juniors was the least accurate: for grade "C" and above there was a decrease from

86 per cent to 40 per cent and for grade "C" and below there was an increase from 57 per cent to 80 per cent. The sophomores were the only ones represented at the extremes, one scoring "A" and three scoring "F".

In general, it seems as though the seniors made better grades than the sophomores inasmuch as the seniors had 80 per cent "C" and above while the sophomores had only 63 per cent "C" and above.

TABLE VI

COMPARISON BY CUMULATIVE PERCENTAGE, ACCORDING TO CLASS,
OF PREVIOUS AND CURRENT STUDENTS
FOR WHOM AN IQ WAS AVAILABLE

Final Grade in Bookkeeping	Sophomore		Junior		Senior	
	Past	Actual	Past	Actual	Past	Actual
A	12%	2%	0	0	18%	0
B and up	34%	26%	43%	20%	47%	40%
C and up	63%	63%	86%	40%	82%	80%
C and down	66%	74%	57%	80%	53%	60%
D and down	38%	37%	14%	60%	18%	20%
F	8%	7%	0	0	0	0

Table VI and Table XVIII, page 37, are the same because the total number of students used in computing these percentages was the same.

The trend as a whole revealed that the grades tended to be slightly lower than previous grades. However, the IQ appears to be of some significance in predicting probable success in first-year bookkeeping.

Comparison of Chronological Age With Final Grade Achievement

The relationship between CA (chronological age) and achievement in first-year bookkeeping is shown in Table XXIX (see page 58). This scattergram covers the years 1950-51, 1951-52, and 1952-53. The chronological age of the students was computed as of May 20th, at which time the final grade was given.

The symbol (x) represents sophomores; the (#), juniors; and the (*), seniors. The next scattergram, Table XXX, page 59, reveals the predicted results for the year 1953-54. Table XXXI, page 60, another scattergram, indicates the current grade results for the year 1953-54.

This relationship shown percentagewise without regard to classification, i.e., sophomore, junior, and senior students grouped together, is presented in Table VII, page 21. The number above shows the past results while the number below reveals the 1953-54 results.

For the fifteen-year olds, we find 61 previous bookkeeping students. Nine, or 15%, made "A"; 21, or 35%, made "B" or above; 46, or 76%, made "C" or above; two, or 3%, made "F";

TABLE VII

COMPARISON BY PERCENTAGE OF PREVIOUS AND CURRENT STUDENTS
FOR WHOM A CA WAS AVAILABLE

CA	Achievement in Bookkeeping					Number of Cases
	F	D	C	B	A	
19 P	-	33%	33%	33%	-	3
19 A	-	-	67%	33%	-	3
18 P	-	36%	36%	21%	7%	14
18 A	-	80%	20%	0	0	5
17 P	9%	26%	22%	30%	13%	23
17 A	0	33 1/3%	33 1/3%	33 1/3%	0	9
16 P	10%	39%	15%	26%	10%	39
16 A	16%	37%	26%	21%	0	18
15 P	3%	21%	41%	20%	15%	61
15 A	4%	19%	46%	27%	4%	26
14 P	-	-	100%	-	-	1
14 A	-	-	0	-	-	0

P - Past Results
A - Actual Results

15, or 24%, made "D" or below while 40, or 65%, made "C" or below. There were 26 students in this age group the current year. One, or 4%, made "A"; eight, or 31%, made "B" or higher; 20, or 77%, made "C" or higher; one, or 4%, made "F"; six, or 23%, made "D" or lower while 18, or 69%, made "C" or lower.

With regard to the 61 previous students comprising the fifteen-year old sophomore group, Table VIII, page 23, nine, or 15%, scored "A"; 21, or 35%, scored "B" or better; 46, or 76%, scored "C" or above; two, or 3%, scored "F"; 15, or 24%, scored "D" or below and 40, or 65%, scored "C" or below. In comparison: one, or 4%, made "A"; eight, or 31%, made "B" or higher; 20, or 77%, made "C" or higher; one, or 4%, made "F"; six, or 23%, made "D" or lower and 18, or 69%, made "C" or lower. There were 26 students in this row.

The juniors were represented by only seven students and were distributed in the following manner on Table IX, page 24.

CA:18: one student scored "D"; CA-17, three students, or 75%, scored "B" and one student, or 25%, scored "C" (100% "C" or better); and for CA-16, two students scored a final grade of "C". For comparison we have two, or 100% of the CA-18 juniors scoring "D" which was the same as previous results for the same row; CA-17, one, or 50%, scored "C" and one, or 50%, scored "D" (100% "C" or under). CA-16, one, or 50%, scored "B" and one, or 50%, scored "D". Obviously there are not enough cases to warrant prognosticating success here.

TABLE VIII

COMPARISON BY PERCENTAGE OF PREVIOUS AND CURRENT SOPHOMORES
FOR WHOM A CA WAS AVAILABLE

CA	P	D	Achievement in Bookkeeping C	B	A	Number of Cases
19	-	-	-	-	-	-
P	-	100%	-	-	-	1
18	-	0	-	-	-	0
P	33%	33%	0	17%	17%	6
17	-	-	-	-	-	-
A	0	67%	33%	0	0	3
P	11%	42%	11%	28%	8%	36
16	-	-	-	-	-	-
A	18%	35%	29%	18%	0	17
P	3%	21%	41%	20%	15%	61
15	-	-	-	-	-	-
A	4%	19%	46%	27%	4%	26
P	-	-	100%	-	-	1
14	-	-	-	-	-	-
A	-	-	0	-	-	0

P - Past Results
A - Actual Results

TABLE IX

COMPARISON BY PERCENTAGE OF PREVIOUS AND CURRENT JUNIORS
FOR WHOM A CA WAS AVAILABLE

CA	P	D	Achievement in Bookkeeping C	B	A	Number of Cases
19						
P	100%					1
18						
A	100%					2
P		0	25%	75%		4
17						
A		50%	50%	0		2
P		0	100%	0		2
16						
A		50%	0	50%		2
P						
15						
A						
P						
14						

P - Past Results
A - Actual Results

There are 29 previous seniors shown on Table X, page 26, 13 of whom were in the CA-17 row, two, or 15%, made "A"; five, or 38%, made "B" or above; nine, or 69%, made "C" or above; no "F's"; four, or 31%, made "D" and eight, or 62%, made "C" or below. There were no "A's"; three, or 75%, made "B" and one, or 25%, made "C", thus accounting for four seniors during the 1953-54 school year (100% "C" or above).

TABLE X

COMPARISON BY PERCENTAGE OF PREVIOUS AND CURRENT SENIORS
FOR WHOM A CA WAS AVAILABLE

CA	P	Achievement in Bookkeeping			A	Number of Cases
		D	C	B		
19	P	33 1/3	33 1/3	33 1/3		3
	A	0	67%	33%		3
	P	25%	42%	25%	8%	12
18	A	67%	33%	0	0	3
	P	31%	31%	23%	15%	13
17	A	0	25%	75%	0	4
	P				100%	1
16	A				0	0
	P					0
15	A					
	P					0
14	A					0

P - Past Results
A - Actual Results

TABLE XI

COMPARISON BY CUMULATIVE PERCENTAGE OF PREVIOUS AND CURRENT STUDENTS FOR WHOM A CA WAS AVAILABLE

CA	P	Achievement in Bookkeeping				A	Number of Cases
		D and Below	C and Below	C and Above	B and Above		
18 P	0	36%	72%	64%	28%	7%	14
18 A	0	80%	100%	20%	0	0	5
17 P	9%	35%	57%	65%	43%	13%	23
17 A	0	33%	67%	67%	33 1/3%	0	9
16 P	10%	49%	64%	51%	36%	10%	39
16 A	16%	53%	89%	47%	21%	0	18
15 P	3%	24%	65%	76%	35%	15%	61
15 A	4%	23%	69%	77%	31%	4%	26

P - Past Results
A - Actual Results

Only those age groups in which the greatest number of students appeared are shown on Table XI, page 27. Because of the wider grade span, the comparison outward ("C" and above and "C" and below) is the most accurate. As we reach the extremes the comparison becomes less accurate due to the decreasing limits of grade span and the smaller number of cases.

The comparison of probable success between past and current results was the most accurate in the case of the seniors, with slightly more deviation in comparing probable success for the sophomores, and a greater deviation in comparing success for the juniors, as shown on Table XII, page 28.

TABLE XII

COMPARISON BY CUMULATIVE PERCENTAGE, ACCORDING TO CLASS,
OF PREVIOUS AND CURRENT STUDENTS
FOR WHOM A CA WAS AVAILABLE

Final Grade in Bookkeeping	Sophomore		Junior		Senior	
	Past	Actual	Past	Actual	Past	Actual
A	12%	2%	0	0	14%	0
B and up	34%	24%	43%	17%	38%	40%
C and up	64%	63%	86%	34%	72%	80%
C and down	65%	76%	57%	83%	62%	60%
D and down	36%	37%	14%	67%	28%	20%
F	8%	9%	0	0	0	0

The reader may wonder why this table has been included because it apparently is the same as Table VI, page 19. However, the percentages are slightly different, the reason being the difference between the total number of students for whom the CA and IQ were available. The CA was available for all students, while the IQ was not.

The sophomore group was the only one to be represented at each extreme (grades "A" and "F"). The juniors were the most disappointing in comparing the past and actual results. They previously had the highest percentage of students who scored

"C" and above (86%), but for this year they had the smallest percentage of students who scored "C" and above (34%). The comparison for seniors had the smallest deviation with a gain from 72 per cent to 80 per cent "C" and above and a decrease from 62 per cent to 60 per cent, "C" and below.

Percentage-wise the seniors made the best grades with the sophomores next and the juniors last. The grades tended, as a whole, to be slightly lower than previous grades, with the comparisons being more accurate at the lower age levels (15-16).

Comparison of Mental Age With Final Grade Achievement

Table XXXII, page 61, shows the relationship between mental age (MA) and achievement in first-year bookkeeping for the years 1950-51, 1951-52, 1952-53.

The symbol (x) again represents sophomores; the (#), juniors and (*), seniors. The next scattergram shows the predicted results (Table XXXIII, page 62) and the third scattergram (Table XXXIV, page 63) reveals the final, actual results. The relationship percentage-wise without regard to grade levels is shown on Table XIII, page 30.

In the sixteen-year old MA group, consisting of 28 previous students, five, or 18%, made "A"; 14, or 50%, made "B" or above; 22, or 79%, made "C" or above; none made "F"; six, or 21%, made "D" and 14, or 50%, made "C" or below. The MA-16 group for 1953-54 consisted of 14 students; none made "A"; five, or 36%, made "B"; nine, or 65%, made "C" or above; one, or 7%,

TABLE XIII

COMPARISON BY PERCENTAGE OF PREVIOUS AND CURRENT STUDENTS
FOR WHOM A MA WAS AVAILABLE

MA	Achievement in Bookkeeping				Number of Cases
	P	D	C	A	
20	P	0	0	0	0
	A	100%	100%	0	1
19	P	0	0	100%	1
	A	100%	100%	0	1
18	P	30%	20%	30%	10
	A	50%	17%	33%	6
17	P	0	36%	37%	11
	A	12%	38%	38%	8
16	P	21%	29%	32%	28
	A	29%	29%	36%	14
15	P	26%	28%	26%	35
	A	18%	53%	29%	17
14	P	45%	22%	16%	27
	A	70%	20%	0	10
13	P	33%	50%	0	12
	A	100%	0	0	1
12	P	25%	75%	0	4
	A	0	0	0	0

P - Past Results

A - Actual Results

made "F"; five, or 36%, made "D" or below and nine, or 65%, made "C" or below.

Table XIV, page 32, shows the breakdown by percentages for the sophomores.

Thirty-two former students in the MA-15 group rated as follows: five, or 16%, made "A"; 12, or 38%, made "B" or better; 21, or 66%, made "C" or better; two, or 6%, made "F"; 11, or 34%, made "D" or less and 20, or 62%, made "C" or less. At present, we find that none made "A"; four, or 29%, made "B"; 11, or 79%, made "C" or above; none made "F"; three, or 21%, made "D" or less and 10, or 71%, made "C" or less.

With regard to the seven juniors on Table XV, page 33, the MA ranged from 13-19 with one student in each MA level except for two students in the MA-15 group. We need only mention that six of the seven juniors scored "C" or above. There were only five juniors this year: three in the MA-18 grouping one, or 33%, scoring "B" and two, or 67%, who scored "D"; one at MA-17 who scored "C" and one at MA-14 who scored "D".

Because of the small number of cases the writer feels that these results are of no significance. It is difficult to determine how many students are needed to make a valid group; however, let us say that 11 students represent a more valid group than seven, and 15 students would have more weight than 11.

TABLE XIV

COMPARISON BY PERCENTAGE OF PREVIOUS AND CURRENT SOPHOMORES
FOR WHOM A MA WAS AVAILABLE

MA	P	D	C	B	A	Number of Cases
19	P					0
	A	25%				0
	P		25%	25%	25%	4
18	A					
	P	33 1/3%	33 1/3%	33 1/3%		3
	A		17%	50%	33%	6
17	P					
	A		33%	50%	17%	6
	P	23%	23%	36%	18%	22
16	A					
	P	10%	40%	20%	0	10
	A	6%	26%	22%	16%	32
15	P					
	A		50%	29%	0	14
	P	16%	24%	16%	0	25
14	A					
	P	11%	67%	0	0	9
	A	18%	45%			11
13	P					
	A	100%				1
12	P					
	A	25%	75%			4
	P	0	0			0

P - Past Results
A - Actual Results

TABLE XV

COMPARISON BY PERCENTAGE OF PREVIOUS AND CURRENT JUNIORS
FOR WHOM A MA WAS AVAILABLE

MA	P	D	Achievement in Bookkeeping	C	B	A	Number of Cases
19	P	0			100%		1
	A				0		0
18	P	0			100%		1
	A	67%			33%		3
	P			0			0
17	P						
	A			100%			1
	P			100%			1
16	P						
	A			0			0
15	P			50%	50%		2
	A			0	0		0
14	P	100%					1
	A	100%					1
13	P			100%			1
	A			0			0

P - Past Results
A - Actual Results

The MA for 17 former seniors ranged from 14-18 as shown on Table XVI, page 35. In the MA-18 grouping one senior scored "A"; one "B" one "C" and two scored "D" and there were no "F's" (three, or 60%, "C" and above and three, or 60%, "C" and under). There were five seniors in this group. The 1953-54 students contained one MA-20 and one MA-19 student, each scoring a final grade of "C", and none in the MA-18 group.

The ranking of five previous seniors in the MA-16 group is as follows: one, or 20%, made a grade of "A"; two, or 40%, made "B" or better; four, or 80%, made "C" or better; none made "F"; one, or 20%, made "D" and three, or 60%, made "C" or below. Four students comprised the group during 1953-54: three, or 75%, made "B" and one, or 25%, made "D" (75% "C" or better and 25% "C" or under).

The grades in general were lower than previous grades except in the case of the MA-15 bracket. The deviations were great enough all along the line to indicate, to the writer at least, that mental age is perhaps not as good a criterion as IQ and/or chronological age. The age groups from 14-18 were used because it was in those groups that the greatest number of students appeared.

TABLE XVI

COMPARISON BY PERCENTAGE OF PREVIOUS AND CURRENT SENIORS
FOR WHOM A MA WAS AVAILABLE

MA	F	Achievement in Bookkeeping				A	Number of Cases
		D	C	B			
P			0				0
20			100%				1
A			0				0
P			100%				1
19			20%				5
A			0				0
P			60%				5
18			100%				1
A			0				0
P			20%				5
17			40%				5
A			0				1
P			25%				5
16			0				1
A			0				5
P			0				1
15			0				3
A			0				1
P			0				0

P - Past Results
A - Actual Results

The comparison in this group, Table XVII, is more accurate as we move from the grade of "C" and up, and "C" and down than it is as we move to the highest and the lowest grades. This is due to the increasing narrowness of the grade span as we move to the extremes and to the small number of cases found at the extremes.

TABLE XVII

COMPARISON BY CUMULATIVE PERCENTAGE OF PREVIOUS AND CURRENT STUDENTS FOR WHOM A MA WAS AVAILABLE

MA	Achievement in Bookkeeping						Number of Cases
	P	D and Below	C and Below	C and Above	B and Above	A	
18 P	0	30%	50%	70%	50%	20%	10
18 A	0	50%	67%	50%	33%	0	6
17 P	0	0	36%	100%	64%	27%	11
17 A	0	12%	50%	88%	50%	12%	8
16 P	0	21%	50%	79%	50%	18%	28
16 A	7%	36%	65%	65%	36%	0	14
15 P	6%	32%	60%	68%	40%	14%	35
15 A	0	18%	71%	82%	29%	0	17
14 P	16%	61%	83%	38%	16%	0	27
14 A	10%	80%	100%	20%	0	0	10

P - Past Results
A - Actual Results

The deviation between previous grades and actual success was least in the case of the sophomores; next, the seniors and finally the juniors had the greatest deviation. The seniors made the best grades, the sophomores were in the middle and the juniors made the poorest grades, as shown on Table

XVIII. This table is the same as Table VI and is shown here for the convenience of the reader.

TABLE XVIII

COMPARISON BY CUMULATIVE PERCENTAGE, ACCORDING TO CLASS,
OF PREVIOUS AND CURRENT STUDENTS
FOR WHOM A NA WAS AVAILABLE

Final Grade in Bookkeeping	Sophomore		Junior		Senior	
	Past	Actual	Past	Actual	Past	Actual
A	12%	2%	0	0	18%	0
B and up	34%	26%	43%	20%	47%	40%
C and up	63%	63%	86%	40%	82%	80%
C and down	66%	74%	57%	80%	53%	60%
D and down	38%	37%	14%	60%	18%	20%
F	8%	7%	0	0	0	0

Comparison of Arithmetical Ability With Final
Grade Achievement

Table XIX, page 38, reveals the percentile ranking of the 1953-54 first-year bookkeeping students on the Hundred-Problem Arithmetic Test. It is interesting to note that 74% of the students are below the 50th percentile based on the national norm for this test which indicates that if the

TABLE XIX

PERCENTILE RANKING ON HUNDRED-PROBLEM ARITHMETIC TEST

1953-54

99
92
86
85
74
72
72
72
67
63
59
57
56
55
51
51
50
50

46
40
40
39
38
38
38
38
38
36
35
34
32
31
31
28
28

26
26
25
25
23
23
23
22
22
21
20
17
15
15
14
14
13

13
13
10
10
10
10
10
9
7
7
6
5
4
3
2
1

assumed positive correlation were true, the grades would be lower than was actually the case. Since there was no record of the arithmetic ability of the 1950-51, 1951-52, 1952-53 bookkeeping students, the percentile ranking placed upon a normal curve will be used as the predicted results. This distribution is shown in Table XXIV, page 64. PORTER LIBRARY

The final results for the year 1953-54, shown in scattergram form, are on Table XXXVI, page 65. Again the (x) represents sophomores; the (#), juniors; and the (*), seniors.

It was arbitrarily assumed that the distribution would be a perfect positive correlation between percentile rank on the Hundred-Problem Arithmetic Test and final grade achievement. The researcher realizes that this is a tremendous assumption and one with little likelihood of being true; however, it is merely a starting point.

The percentages found for 1953-54 in Tables XX - XXIII, pages 40-44, are also the percentages used for prediction of current achievement in bookkeeping based upon percentile rank distributed upon a normal curve.

According to their percentile ranking, on Table XX, page 40, we observe that at the 8-31 level 100% will make "D". In comparison, in the same row for 1953-54 we find 26 students none of whom made "A"; seven, or 27%, made "B"; 16, or 62%, made "C" or above; two, or 8%, made "F"; ten, or 39%, made "D" or below while 19, or 74%, made "C" or below.

TABLE XX

COMPARISON BY PERCENTAGE OF PREDICTED AND ACTUAL RESULTS
(STUDENTS FOR WHOM AN ARITHMETIC SCORE WAS AVAILABLE)

Percent- Normal Distri- bution		Achievement in Bookkeeping					Number of Cases
ile Rank Based on Natl. Norm.		P	D	C	B	A	
7%	94-100	P			0	100%	1
	A				100%	0	1
24%	70-93	P			100%		7
	A		20%	20%	40%	20%	5
30%	32-69	P			100%		23
	A	4%	27%	48%	21%	0	23
24%	8-31	P			100%		30
	A	8%	31%	35%	27%	0	26
7%	1-7	P			100%		8
	A	14%	57%	29%			7

P - Past Results
A - Actual Results

The comparison of percentile ranking and final grade achievement for sophomores is disclosed on Table XXI, page 42.

Of the 19 students in the 8-31 range: none made "A"; four, or 21%, made "B"; 11, or 58%, made "C" or higher; two, or 11%, made "F"; eight, or 43%, made "D" or lower and 15, or 80%, made "C" or lower.

The percentages for seven juniors are found on Table XXII, page 43.

With only six juniors represented during 1953-54, we find none with a percentile ranking above 70. For the range 32-69 we find two, or 100%, scored "D"; 8-31, one, or 33 1/3%, scored "B"; two, or 67%, made "C" or above; none made "F"; one, or 33 1/3%, made "D" and two, or 67%, made "C" or under. One, or 100%, made "D" in the 1-7 percentile group. Because of the small number of cases this group cannot be considered valid for prognosticating success in bookkeeping.

Eleven seniors are shown on Table XXIII, page 44, with none making a grade of "A", and none in the brackets 94-100 and 70-93. In the 32-69 range, two, or 50%, made "B" and four, or 100%, made "C" or above. The 8-31 range contained four students: two, or 50%, made "B"; three, or 75%, made "C" or higher; none made "F"; one, or 25%, made "D" and two, or 50%, made "C" or lower. For the final range, 1-7, there were two students: one scored "C" and one scored "D", making two, or 100%, "C" or less.

TABLE XXI

COMPARISON BY PERCENTAGE OF PREDICTED AND ACTUAL RESULTS
(SOPHOMORES FOR WHOM AN ARITHMETIC SCORE WAS AVAILABLE)

Normal Distri- bution	Percent- ile Rank Based on Natl. Norm	Achievement in Bookkeeping					Number of Cases
		P	D	C	B	A	
7%	94-100	P	-	-	-	100%	1
		A	-	-	100%	-	1
24%	70-93	P	-	-	100%	-	7
		A	20%	20%	40%	20%	5
38%	32-69	P	-	-	100%	-	17
		A	6%	24%	53%	18%	17
24%	8-31	P	-	100%	-	-	22
		A	11%	32%	37%	21%	19
7%	1-7	P	100%	-	-	-	4
		A	25%	50%	25%	-	4

P - Past Results
A - Actual Results

TABLE XXII

COMPARISON BY PERCENTAGE OF PREDICTED AND ACTUAL RESULTS
(JUNIORS FOR WHOM AN ARITHMETIC SCORE WAS AVAILABLE)

Percent- Normal Distri- bution		Achievement in Bookkeeping					Number of Cases
Based on Natl. Norm		P	D	C	B	A	
7%	P	---	---	---	---	---	0
	A	---	---	---	---	---	0
24%	P	---	---	---	0	---	---
	A	---	---	---	0	---	---
38%	P	---	0	100%	---	---	2
	A	---	100%	0	---	---	2
24%	P	---	100%	0	0	---	4
	A	---	33 1/3%	33 1/3%	33 1/3%	---	3
7%	P	100%	0	---	---	---	1
	A	0	100%	---	---	---	1

P - Past Results

A - Actual Results

TABLE XXIII

COMPARISON BY PERCENTAGE OF PREDICTED AND ACTUAL RESULTS
(SENIORS FOR WHOM AN ARITHMETIC SCORE WAS AVAILABLE)

Percent-		Achievement in Bookkeeping					
Normal Distri- bution	ile Rank Based on Nation	P	D	C	B	A	Number of Cases
7%	94-100	P				0	
	A					0	
24%	70-93	P			0		
	A				0		
38%	32-69	P		100%	0		4
	A			50%	50%		4
24%	8-31	P	100%	0	0		4
	A		25%	25%	50%		4
7%	1-7	P	100%				3
	A	0	50%	50%			2

P - Past Results
A - Actual Results

TABLE XXIV

COMPARISON BY CUMULATIVE PERCENTAGE OF PREDICTED AND ACTUAL RESULTS
(STUDENTS FOR WHOM AN ARITHMETIC SCORE WAS AVAILABLE)

		Achievement in Bookkeeping						Number of Cases
Normal Distri- bution	Percent- ile Rank Based on Natl. Norm	P	D and Below	C and Below	C and Above	B and Above	A	
7%	94-100	P				0	100%	1
		A				100%	0	1
24%	70-9	P				100%		7
		A				60%	20%	5
		P				100%		23
38%	32-69	P						
		A				69%	21%	23
		P				100%		30
24%	8-31	P						
		A				62%	0	26
		P				100%		8
7%	1-7	P						
		A				100%		7

P - Past Results

A - Actual Results

The comparison is more accurate from the grades of "C" to "A" inclusive and "C" to "F" inclusive than it is as we move to the extremes because of the decreasing limits in which to work and the smallest number of cases is found at the extremes.

Because of the nature of the prediction in this case (prediction of perfect correlation) and the expected resulting scatter from the prediction, this writer must necessarily conclude that perhaps the arithmetical ability of students is not as good a criterion as intelligence quotient and/or chronological age. As it pertains to arithmetic ability, this agrees with what MacDonald found: "the correlation of .46 between arithmetical ability and bookkeeping achievement indicates that arithmetic test scores are of only slight value in predicting bookkeeping achievement."¹⁹

The cumulative percentages shown on Table XXV reveal that the greatest deviation occurred in the case of the seniors who scored much better than was expected, the juniors fell below expectations and the sophomores did better than was expected. The deviation for juniors and sophomores was about the same.

¹⁹ Donald D. MacDonald, "A Study of the Relative Value of Vocabulary Scores and Arithmetical Ability in Predicting Bookkeeping Achievement, with an Incidental Investigation into Vocabulary Building and Arithmetical Improvement" (Unpublished Master's thesis, University of Michigan, 1939), p. 42.

TABLE XXV

COMPARISON BY CUMULATIVE PERCENTAGE, ACCORDING TO CLASS,
OF PREDICTED AND ACTUAL RESULTS
(STUDENTS FOR WHOM AN ARITHMETIC SCORE WAS AVAILABLE)

Final Grade in Bookkeeping	Sophomore		Junior		Senior	
	Past	Actual	Past	Actual	Past	Actual
A	2%	2%	0	0	0	0
B and up	16%	24%	0	17%	0	40%
C and up	49%	63%	29%	34%	36%	80%
C and down	84%	76%	100%	83%	100%	60%
D and down	51%	37%	57%	67%	64%	20%
F	8%	9%	14%	0	27%	0

The seniors made the best grades having 80% "C" and above, the sophomores next with 63% "C" and above and the juniors made the poorest showing with only 34% "C" and above. The difference between the percentages on this table and those on Table XII, page 28 (in the predicted columns only), is due to the difference in total number of students used for each table.

CHAPTER III

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

Summary

The purpose of this study was to determine if any of the four factors (intelligence quotient, chronological age, mental age and arithmetical ability) are valid measures for prognosticating success in first-year bookkeeping.

Scattergrams were used to show the relationship between IQ, MA and CA and success in first-year bookkeeping using students for the three years, 1950-51, 1951-52, 1952-53. This information was then converted into percentages not only for the entire group but also for the three classes: sophomore, junior, and senior. Using this data, the probable success for the first-year bookkeeping students of 1953-54 was plotted on scattergrams in a similar manner.

In addition, the 1954 bookkeeping students were given the Hundred-Problem Arithmetic Test and the percentile rankings were plotted on a normal distribution and this was used as the basis for predicting their probable success.

The actual success was then compared to the predicted success.

Conclusions

The reliability of any statistical measure varies directly with the number of individuals on which the measure is based. Since each cell is likely to contain relatively few cases, the confidence to which we are entitled is less than for measures based on larger numbers of cases. One should recall that the average score of a class is a more stable figure than the score of any individual students. The lesser reliability of individual cell entries (or per cents) is a real limitation of the expectancy table technique, and one of which the user should always be conscious. The limitation is not so great as to vitiate the usefulness of the device. The coefficients computed in most school and industrial situations also fall short of ideal levels of reliability. The lesser reliability of the figures in any expectancy table is frequently compensated for by the clearer interpretation they permit. It should also be remarked that larger frequencies in each cell, and consequently greater permissible confidence in our predictions, may be obtained by lumping together adjacent score groups or criterion ratings ... in short, the expectancy table is a tool, and one of potentially considerable value. Like any tool, its usefulness depends on the extent to which it is understood and on the ingenuity and skill of its user. Properly understood, it represents an excellent medium for interpretation and communication of the meaning of test results.¹

The writer draws the following conclusions from the results of this study:

(1) The sophomore class emerged as the one in which the comparisons were the most accurate, possibly because this was the largest group.

(2) The intelligence quotient and chronological age of the student appear to be more influential in predicting

¹The Psychological Corporation, publisher (Test Service Bulletin, No. 38, December, 1949, New York, N. Y.), pp. 4-5.

probable success in bookkeeping than do the mental age and arithmetical ability. The correlation for IQ is positive while the correlation for CA is negative. There is almost no correlation between mental age and bookkeeping achievement and the correlation for arithmetical ability is positive to a very slight degree.

(3) The seniors consistently made better grades than the sophomores with the juniors making the poorest grades of the three classes.

(4) The current grades as a whole tended to be slightly lower than previous grades.

Recommendations

The results of this study indicate that the following recommendations be made:

(1) That a larger number of students be used in making a similar study.

(2) That a more statistical approach be made to the problem.

(3) That first-year bookkeeping be offered as a senior subject.

BIBLIOGRAPHY

APPENDIX

HUNDRED-PROBLEM ARITHMETIC TEST

WHOLE NUMBERS—COMMON FRACTIONS—DECIMAL FRACTIONS—PER CENTS

By RALEIGH SCHORLING

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V

TOTAL NUMBER RIGHT	
%-ILE RANK	

TEST: FORM V

Name..... Date..... Grade.....

Age..... years and months. Teacher

School..... City..... State.....

DIRECTIONS

Do not turn this page until you are told to do so. Read the following directions.

This test contains several groups of arithmetic examples. When you finish one group, go right on to the next. If you come to an example that you cannot do, skip it and try it again later if you have time. Begin at the top of each column and work down the page.

You are not expected to finish every example, but work steadily and do the best you can.

You may do your figuring on the test paper or on the blank paper that has been given you. But you must be sure to **write the answer to each example in the box near the example.**

Do not turn the page until I say the word *Begin*.

PARTS	NUMBER CORRECT	+	NUMBER WRONG	+	NUMBER OMITTED	=	TOTAL NUMBER
I. Addition.....		+		+		=	10
II. Subtraction.....		+		+		=	10
III. Multiplication.....		+		+		=	15
IV. Division.....		+		+		=	15
V. Fractions, Decimals, and Per Cents....		+		+		=	50
VI. Total.....		+		+		=	100

[This test is a revision of the *Schorling-Clark-Potter Arithmetic Test*, Form A (1928).]

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a

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I. ADDITION

Add:

$$\begin{array}{r} 1. \ 8 \\ 7 \\ 3 \\ 6 \\ 9 \\ 5 \\ 8 \end{array}$$

$$\boxed{} \quad (1)$$

$$\begin{array}{r} 2. \ 463 \\ 877 \\ 539 \\ 198 \end{array}$$

$$\boxed{} \quad (2)$$

$$\begin{array}{r} 3. \ \$386.85 \\ 96.66 \\ 6.57 \\ .98 \\ 100.00 \\ 5.94 \\ 60.00 \end{array}$$

$$\boxed{} \quad (3)$$

$$\begin{array}{r} 4. \ \frac{7}{10} \\ \frac{3}{5} \end{array}$$

$$\boxed{} \quad (4)$$

$$5. \ \frac{7}{8} + \frac{3}{16} = \boxed{} \quad (5)$$

$$\begin{array}{r} 6. \ 17\frac{5}{8} \\ 5\frac{1}{3} \end{array}$$

$$\boxed{} \quad (6)$$

$$7. \ \frac{3}{5} + \frac{1}{2} + \frac{7}{10} = \boxed{} \quad (7)$$

$$\begin{array}{r} 8. \ 9\frac{3}{4} \\ 27\frac{7}{8} \\ 8\frac{9}{16} \end{array}$$

$$\boxed{} \quad (8)$$

$$9. \ .07 + 5.23 + 8.29 + 1.40 = \boxed{} \quad (9)$$

$$10. \ \$2.25 + \$14.70 = \boxed{} \quad (10)$$

II. SUBTRACTION

Subtract:

$$\begin{array}{r} 11. \ 1124 \\ 742 \\ \hline \end{array} \quad (11)$$

$$\begin{array}{r} 12. \ 880.75 \\ 785.78 \\ \hline \end{array} \quad (12)$$

$$13. \ \frac{11}{12} - \frac{1}{6} = \boxed{} \quad (13)$$

$$\begin{array}{r} 14. \ 8\frac{3}{8} \\ 5\frac{3}{4} \\ \hline \end{array} \quad (14)$$

$$15. \ 2\frac{3}{4} - \frac{2}{3} = \boxed{} \quad (15)$$

$$16. \ \$5.04 - 18\text{¢} = \boxed{} \quad (16)$$

$$17. \ 9.752 - 6.007 = \boxed{} \quad (17)$$

$$18. \ \$32 - \$6.58 = \boxed{} \quad (18)$$

$$19. \ 9.25 - 2.20 = \boxed{} \quad (19)$$

$$\begin{array}{r} 20. \ 9006 \\ 4039 \\ \hline \end{array} \quad (20)$$

III. MULTIPLICATION

Multiply:

$$\begin{array}{r} \text{Do your work here.} \\ 95 \\ 82 \\ \hline \end{array} \quad \begin{array}{r} 21. \ 95 \\ 82 \\ \hline \end{array} \quad (21)$$

Write your answer in the box.

$$\begin{array}{r} \text{Do your work here.} \\ 609 \\ 40 \\ \hline \end{array} \quad \begin{array}{r} 22. \ 609 \\ 40 \\ \hline \end{array} \quad (22)$$

Write your answer in the box.

$$\begin{array}{r} \text{Do your work here.} \\ 769 \\ 708 \\ \hline \end{array} \quad \begin{array}{r} 23. \ 769 \\ 708 \\ \hline \end{array} \quad (23)$$

Write your answer in the box.

$$24. \ \frac{3}{4} \times 60 = \boxed{} \quad (24)$$

$$25. \ \frac{5}{4} \times \frac{3}{2} = \boxed{} \quad (25)$$

$$26. \ \frac{5}{8} \times \frac{12}{10} = \boxed{} \quad (26)$$

$$27. \ 45 \times \frac{2}{5} = \boxed{} \quad (27)$$

$$28. \ 20\frac{3}{5} \times 12 = \boxed{} \quad (28)$$

$$29. \ 1\frac{1}{2} \times 2\frac{1}{4} \times \frac{3}{4} = \boxed{} \quad (29)$$

$$\begin{array}{r} \text{Do your work here.} \\ 4.928 \\ 3.2 \\ \hline \end{array} \quad \begin{array}{r} 30. \ 4.928 \\ 3.2 \\ \hline \end{array} \quad (30)$$

Write your answer in the box.

When you finish this part, go right on with the next.

When you finish this part, go right on with the next.

(Part III is continued on the next page.)

III. MULTIPLICATION

(Continued)

The answers in the following examples have not been "pointed off." Put the decimal point in each answer where it belongs.

31. $20 \times .20 =$ (31)

32. $1.6 \times 0.3 =$ (32)

33. $0.5 \times 5 =$ (33)

34. $0.245 \times 2 =$ (34)

35. Does 1.2×0.5 equal 6.0 or .60 or .060 or 60? (35)

When you finish this part, go right on with the next.

IV. DIVISION

Divide:

36. $36 \div 3 =$ (36)

37. $636 \div 6 =$ (37)

38. $948 \div 9 =$ (38)

39. $.004 \overline{)0.0284}$ (39)

40. $.34 \overline{)105.4}$ (40)

The answers in the following examples have not been "pointed off." Place the decimal point in each answer where it belongs, adding zeros when necessary.

41. $456 \overline{)123560.88}$ (41)

42. $1.23 \overline{)560.88}$ (42)

43. $12.3 \overline{)560.88}$ (43)

44. Does $4786 \div 10$ equal 4.786 or 47.86 or 478.6 or 4786? (44)

45. $2\frac{1}{2} \div 4\frac{1}{2} =$ (45)

46. $3\frac{3}{4} \div \frac{3}{4} =$ (46)

47. $\frac{3}{8} \div 4 =$ (47)

48. $4\frac{1}{2} \div 8 =$ (48)

49. $21 \overline{)882}$ (49)

50. $83 \overline{)11371}$ (50)

When you finish this part, go right on with the next.

V. FRACTIONS, DECIMALS, AND PER CENTS

Write each of the following as per cent:

SAMPLE $\frac{1}{5} =$ (Your answer should read $\frac{1}{5} = 20\%$.)

51. $\frac{3}{100} =$ (51)

52. $\frac{3}{5} =$ (52)

53. $\frac{5}{8} =$ (53)

54. $.75 =$ (54)

55. $.075 =$ (55)

56. $\frac{4}{5} =$ (56)

57. $\frac{1}{3} =$ (57)

58. $\frac{3}{8} =$ (58)

59. $.2 =$ (59)

60. $0.875 =$ (60)

Write each of the following as a decimal fraction:

61. $\frac{3}{10} =$ (61)

62. $\frac{1}{4} =$ (62)

63. $\frac{2}{5} =$ (63)

64. $60\% =$ (64)

65. $7\frac{1}{2}\% =$ (65)

66. $\frac{7}{100} =$ (66)

67. $\frac{3}{5} =$ (67)

68. $\frac{1}{8} =$ (68)

(Part V is continued on the next page.)

PART V. (Continued)

Write each of the following as a decimal fraction:

69. $12\frac{1}{2}\%$ = (69)

70. $37\frac{1}{2}\%$ = (70)

Write each of the following as a common fraction:

71. 20% = (71)

72. 9% = (72)

73. 25% = (73)

74. $12\frac{1}{2}\%$ = (74)

75. $33\frac{1}{3}\%$ = (75)

Complete the following:

76. 25% of 120 = (76)

77. 2.3% of 40 = (77)

78. 120% of 20 = (78)

79. $\frac{2}{3}\%$ of 3000 = (79)

80. % of 24 = 8.

81. % of 60 = 6.

82. % of 20 = 25.

83. 4 = % of 20.

84. 9 = % of 18.

85. 8 = % of 80.

Write these decimals as per cents:

86. .355 = % (86)

87. .123 = % (87)

88. .1825 = % (88)

Rewrite the following decimals, arranging them in the order of their size, the largest first and the smallest last:

89. .93 .15 .94 (89)

90. .40 2.5 .875 (90)

Write these as decimal fractions; carry the answer to three places and round off to two places:

91. $\frac{7}{16}$ = (91)

92. $\frac{5}{16}$ = (92)

93. Mary bought an \$8 dress at a 15% discount. What did she pay for the dress? (93)

94. What is the interest for a year on \$175 at 6%? (94)

95. Mr. Brown found that $22\frac{1}{2}\%$ of his peaches were not good enough to sell. Out of 80 bushels he could sell bushels. (95)

96. Carl earned \$32 during his summer vacation. He spent $14\frac{1}{2}\%$ of this money for schoolbooks. How much did his books cost? (96)

97. What do you pay for goods marked \$13.50 with a discount of 2%? (97)

98. What per cent of your investment do you make if you invest \$125 and gain \$5? % (98)

99. What is the interest for a year on \$300 at $4\frac{1}{2}\%$? (99)

100. There are 2150 pupils in one junior high school of this city. The principal of this school expects an increase of 6% in the number of pupils next semester. How many pupils does he plan to have next semester? (100)

When you finish this part, go back and make sure that your work is correct.

TABLE XXVI

SCATTERGRAM OF PREVIOUS RESULTS
(STUDENTS FOR WHOM AN IQ WAS AVAILABLE)

IQ	F	D	Achievement in Bookkeeping C	E	A	Number of Cases
120-129						1
			X			
110-119						
		XXX 40	XXXX 80	# XXXX 80	XXXX 80	21
100-109						
		XXXX 80	XXXX XXX 80-89	# XX 80	XXXX 80	38
90-99		XXXX XX XXXX XXXX	XXXX XXXX 80-89	# 80		49
	XXXX		XXXX XXXX	XXXX X 80	X	
80-89						
		#	#			17
	XXX	XXXX	XXXX X			
70-79						
		X				2
		(X) sophomore	(#) junior	(*) senior		

SCATTERGRAM OF PREDICTED RESULTS
(STUDENTS FOR WHOM AN IQ WAS AVAILABLE)

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TABLE XXVIII

SCATTERGRAM OF CURRENT GRADE RESULTS
(STUDENTS FOR WHOM AN IQ WAS AVAILABLE)

IQ	Achievement in Bookkeeping				Number of Cases
	P	D	C	A	
120-129			e		0
110-119			#		8
100-109				X	20 ¹
90-99					22 ²
80-89					7
70-79					1

(e) senior

(#) junior

(x) sophomore

1 four students dropped out of school

2 five students dropped out of school

TABLE XXIX

SCATTERGRAM OF PREVIOUS RESULTS
(STUDENTS FOR WHOM A CA WAS AVAILABLE)

CA	F	Achievement in Bookkeeping			Number of Cases
		D #	C #	B #	
19					3
18		#			14
17		X XXXX	####	###	23
16	XX	XX	##	X	39
15	XXXX XXXXX XXXX XXXX	XXXXX XXXXX XXXX XXXX XXXX	XXXX XXXXX XXXX XXXX XXXX	XXXX XXXX XXXX XXXX	61
14	XX	XXXXX XXX XXXXX XXX	XXXXX XXXX XXXXX XXXX XXXX XXXX	XXXX XXXX XXXX XXXX	1
		(X) sophomore	X (#) junior	(*) senior	

TABLE XXI

SCATTERGRAM OF PREDICTED RESULTS
(STUDENTS FOR WHOM A CA WAS AVAILABLE)

CA	Achievement in Bookkeeping				Number of Cases
	P	D	C	B	
19		*	*	*	3
18		##	##	*	7
17		X ##	##	##	10
16	X	X		X	22
15	XX	XXXX XXX	XX	XXXX X XX	29
14	X	XXXX X	XX	XXXX X XXXX	0
	(x) sophomore (#) junior (*) senior				

TABLE XXXI

SCATTERGRAM OF CURRENT GRADE RESULTS
(STUDENTS FOR WHOM A CA WAS AVAILABLE)

CA	Achievement in Bookkeeping				Number of Cases
	F	D	C	A	
19			**	*	3
18		** ##	*		5 ¹
17		# XX	* # X	***	9 ²
16	XXX	XXXXX X	XXXXX	# XXX	19 ³
15	X	XXXXX	XXXXX XXXXX XX	XXXXX XX X	26 ⁴
14					0
<div> <div>(x) sophomore</div> <div> <div>1¹Two students dropped out</div> <div>2⁰One student dropped out</div> </div> </div> <div> <div>(#) junior</div> <div> <div>3³Three students dropped out</div> <div>4¹Three students dropped out</div> </div> </div> <div> <div>(*) senior</div> </div>					

TABLE XXII

SCATTERGRAM OF PREVIOUS RESULTS
(STUDENTS FOR WHOM A MA WAS AVAILABLE)

MA	F	D	Achievement in Bookkeeping	A	Number of Cases
			C	B	
19			#		1
18		**	*	*	10
17		X	X ***	X *	11
16		*	X **	XX *	28
15	XX	XXXX XXX	XXXX #	XXXX XXX *	35
14		XXXX XXX	XXXX XXX #	XXXX XX *	27
13	XXXX	XXXX X	XXXX X	XXXX	12
12	XX	XXXX	XXXX		4
		X	XX		
	(x) sophomores	(#) juniors	(*) seniors		

TABLE XXXIV

SCATTERGRAM OF CURRENT GRADE RESULTS
(STUDENTS FOR WHOM A NA WAS AVAILABLE)

NA	F	D	Achievement in Bookkeeping		A	Number of Cases
			C	B		
20			#			1
			*			
19						1
18		##		#		6
		X	X	X		
		#				
17			#			8 ¹
			XX	XXX ###	X	
16		#				14 ²
	X	XXX	XXXX	XX		
			##	#		
15			XXXX XX	XXXX		17 ³
		XXX				
14		#				10
	X	XXXX X	XX			
13						1
	X					

(X) sophomores

(#) juniors

(*) seniors

¹One student dropped out²Three students dropped out³Three students dropped out

TABLE XXXV

SCATTERGRAM OF PREDICTED RESULTS
(STUDENTS FOR WHOM AN ARITHMETIC SCORE WAS AVAILABLE)

Percent- Normal Distri- bution		Achievement in Bookkeeping					Number of Cases
ile Rank Based on Natl. Norm		F	D	C	B	A	
7%	94-100					X	1
24%	70-93						7
38%	32-69			XXXX	XXXX XX		23
24%	8-31		XXXX ##### XXXXX XXXX XXXXX XXXX XX	XXXX XXXX XXXX XX			30
7%	1-7	XXX #	XXXX				8
		(x) sophomores	(#) juniors			(*) seniors	

TABLE XXXVI

SCATTERGRAM OF CURRENT GRADE RESULTS
(STUDENTS FOR WHOM AN ARITHMETIC SCORE WAS AVAILABLE)

Percent- ile Rank Based on Normal Distri- bution		Achievement in Bookkeeping				Number of Cases
F	F	D	C	B	A	
7%	94-100			X		1
24%	70-93			X		5 ¹
30%	32-69	X	X	XX	X	23
24%	8-31	XX	XXXX XXX	XXX		26 ²
7%	1-7	XX	XXXX X	XXXX XX	XXX	7 ³
		X	(x) sophomores	(#) juniors	(*) seniors	
		1Two students dropped out				3One student dropped out
		2Four students dropped out				